MULTIMEDIA UNIVERSITY

STUDENT ID NO

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# MULTIMEDIA UNIVERSITY

# FINAL EXAMINATION

**TRIMESTER 2, 2015/2016**

## TCS 2241 – COMPUTATIONAL SCIENCE

( All sections / Groups )

9 MARCH 2016
9.00 a.m – 11.00 a.m
(2 Hours)

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**INSTRUCTIONS TO STUDENTS**

1. This Question paper consists of 6 pages (excluding cover page) with 6 Questions.
2. Attempt **FIVE** out of **SIX** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided

## Question 1

(a) Consider the following Linear Programming problem.

Maximize profit (in RM) $Z = 3x_1 + 3x_2$

Subject to the constraints

$$\begin{aligned} 2x_1 &\leq 16 \\ x_1 + 3x_2 &\leq 17 \\ x_2 &\leq 5 \\ x_1, x_2 &\geq 0 \end{aligned}$$

(i) Solve the problem by using graphical method. Show the feasible corner points and compute optimal solution. [3 marks]

(ii) Assume $x_1$ be the number of product 1 and $x_2$ be the number of product 2. Suppose there is a sudden rise in the demand for product 1 that increases the profit to RM7 per unit. However, this change has made the profit of product 2 to reduce to RM1 per unit. Is there any change to the optimal solution? Please verify your answer. [2 marks]

(iii) Suppose there is no change in the original objective function. However, an additional constraint is made available. The constraint is $2x_2 \geq 12$. Determine the effect of the additional constraint to the problem. [2 marks]

(b) The given situation is a hypothetical furniture-manufacturing company.

- A bookcase requires three hours of work, one unit of metal and four units of wood. It brings in a net profit of RM 19.
- A desk requires two hours of work, one unit of metal and three units of wood. It brings in a net profit of RM 13.
- A chair requires one hour of work, one unit of metal and three units of wood. It brings in a net profit of RM 12.
- A bed frame requires two hours of work, one unit of metal and four units of wood. It brings in a net profit of RM 17.

There are only 225 hours of labour, 117 units of metal and 420 units of wood available per day. Define decision variables ($x_1$, $x_2$, $x_3$, $x_4$), objective function (maximize or minimize) and constraints that fulfills this situation. [3 marks]

**Continued...**

## Question 2

Given an initial simplex table for a Linear Programming problem:

| Basic Variable | Coefficient of: | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Z** | **$x_1$** | **$x_2$** | **$x_3$** | **$x_4$** | **$x_5$** | **$x_6$** | **$x_7$** | **Solution** |
| Z | 1 | -2 | 1 | -1 | 0 | 0 | 0 | 0 | 0 |
| $x_4$ | 0 | 1 | -1 | 3 | 1 | 0 | 0 | 0 | 4 |
| $x_5$ | 0 | 2 | 1 | 0 | 0 | 1 | 0 | 0 | 10 |
| $x_6$ | 0 | 1 | -1 | -1 | 0 | 0 | 1 | 0 | 7 |
| $x_7$ | 0 | -1 | 1/4 | 5/7 | 0 | 0 | 0 | 1 | 5 |

(a) State the objective function and constraints in standard equation form.

[3 marks]

(b) Suppose this is a maximization problem, identify the nonbasic variables that have potential to improve the value of Z. Please explain.

[2 marks]

(c) After selecting the entering variable, determine the respective leaving variable from the simplex table. Prove it.

[2 marks]

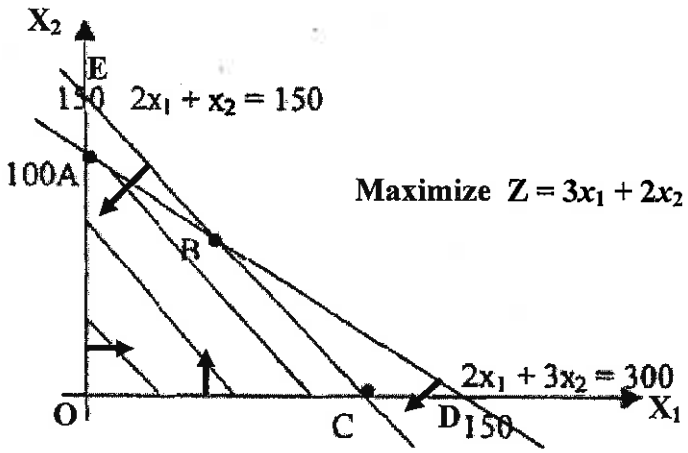
(d) Discuss **TWO** special cases that arise in the use of simplex method. How do you identify these special cases from the final iteration of a simplex table?

[3 marks]

**Continued...**

## Question 3

Consider the following Linear Programming problem with the shaded feasible space in graph.




(a) Use algebraic method to compute the number of basic solutions using $C_e^v$.

[2 marks]

(b) Classify the basic solutions as feasible and infeasible and determine the optimum basic feasible solution in the following table.

[4 marks]

| Non Basic variables | Basic variables | Basic solution | Feasible | Objective value, Z |
|---|---|---|---|---|
| $(x_1, x_2)$ | $(x_3, x_4)$ | (?, ?) | Yes / No | ? |
| ... | ... | ... | ... | ... |

(c) Identify each basic solution that correspond to the points from the graph (**O, A, B, C, D** and **E**).

[3 marks]

(d) Identify the path of simplex algorithm from the graph

[1 mark]

**Continued...**

## Question 4

(a) ITServer Holdings has 2 factories that produce computer mainframe servers. The servers from these factories have to be delivered to 3 cities. The transportation table below provides the cost on the supplies from each factory and demands for each city.

| | City 1 | City 2 | City 3 | Supply |
|---|---|---|---|---|
| **Factory A** | 24 | 30 | 40 | 50 |
| **Factory B** | 30 | 40 | 42 | 50 |
| **Demand** | 25 | 45 | 10 | |

(i) The above table representation has violated the assumption that transportation model is **balanced**. Why? Please restore the table to a balanced model.

[2 marks]

(ii) Compare the initial basic feasible solutions obtained by Northwest-corner and Vogel methods.

[5 marks]

(b) The following table represents a particular iteration of Hungarian method to minimize the cost of assigning 4 tasks to 4 workers.

| | | | |
|---|---|---|---|
| 23 | 1 | 8 | 0 |
| 9 | 3 | 5 | 0 |
| 0 | 2 | 4 | 0 |
| 0 | 0 | 0 | 2 |

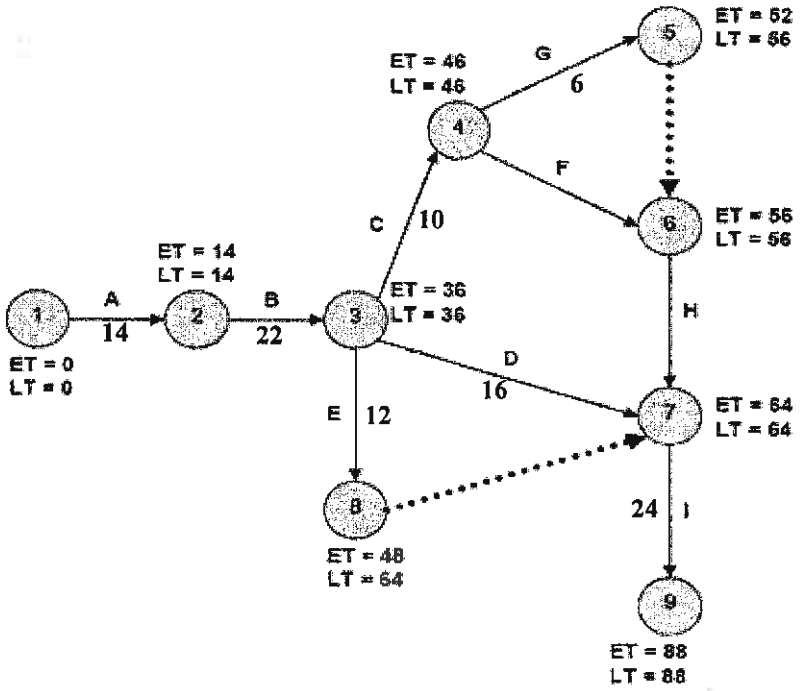
Can you determine an optimal solution from this iteration? If yes, show the optimal solution. If no, explain your next step to achieve optimal solution?

[3 marks]

**Continued...**

## Question 5

(a) Given the network diagram with its associated activities, duration, earliest and latest activity times (ET, LT).



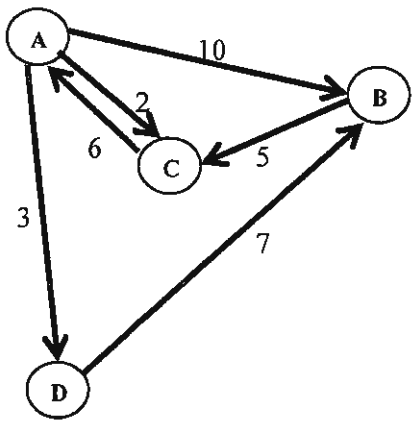

(i) Find the critical path and calculate the time duration of activities **F** and **H**.

[1 mark]

(ii) Compute the total and free floats (TF, FF) for noncritical activity **G**. When should activity **G** start? How long can activity **G** delay its starting time without affecting the start time of its successor activities?

[3 marks]

(b) Given the network diagram with its indicated distance in every edge.




**Continued...**

(i) Consider the following final iteration matrices, $D_4$ and $S_4$ from Floyd's algorithm. Determine the shortest path and distance between the pairs of nodes: node **A** to node **C** and node **B** to node **D**.

$D_4$

| | A | B | C | D |
|---|---|---|---|---|
| A | - | 10 | 2 | 3 |
| B | 11 | - | 5 | 14 |
| C | 6 | 16 | - | 9 |
| D | 18 | 7 | 12 | - |

$S_4$

| | A | B | C | D |
|---|---|---|---|---|
| A | - | B | C | D |
| B | C | - | C | C |
| C | A | A | - | A |
| D | C | B | B | - |

[2 marks]

(ii) Use Dijkstra's algorithm to find the shortest route from node **A** to node **B**. Show the every iterations in the following table.

[4 marks]

| Node | Label | Status T / P | Change In Status | | Node | Label | Status T / P | Change In Status |
|---|---|---|---|---|---|---|---|---|
| **Iteration 1** | | | | | **Iteration 2** | | | |
| A | [0,–] | P | | | A | [0,–] | P | |
| ... | ... | ... | ... | | ... | ... | ... | ... |

## Question 6

(a) A manufacturer of greeting cards must determine the order size of a popular line of cards. The demand for these cards has been a fairly steady 180,000 per year. The manufacturer is currently using an order size of 90,000. The ordering cost is RM1000 each time an order is placed. Assume that for each card the cost is RM0.50 and storage costs at 20 percent of the value of each card.

(i) What is the optimal order size that minimizes the total inventory cost?

[1.5 marks]

(ii) Compute the optimal inventory cost and determine the additional annual cost resulting from using the wrong order size.

[2.5 marks]

(b) Solve the following non-linear programming problem by using the **Lagrangian method**.

[6 marks]

Maximize $Z = 42x - 5x^2 + 15y - 10y^2$

Subject to the contraints

$3x + 2y = 21$

$x, y \geq 0$

**End of Paper.**